



### ALHAT Flash Lidar

NASA considers Flash Lidar a critical technology for enabling autonomous safe landing of future large robotic and crewed vehicles on the surface of the Moon and Mars. Flash Lidar can generate 3-Dimensional images of the terrain to identify hazardous features such as craters, rocks, and steep slopes during the final stages of descent and landing. The onboard flight computer can use the 3-D map of terrain to guide the vehicle to a safe site. The capabilities of Flash Lidar technology were evaluated through a series of static tests using a calibrated target and through dynamic tests aboard a helicopter and a fixed wing aircraft. The aircraft flight tests were performed over Moon-like terrain in the California and Nevada deserts.

### ALHAT Doppler Lidar

A navigation Doppler Lidar (DL) is being developed at NASA Langley Research Center (LaRC) for high precision velocity measurements from a lunar or planetary landing vehicle in support of the Autonomous Landing and Hazard Avoidance Technology (ALHAT) project. A unique feature of this DL is that it has the capability to provide a precision velocity vector which can be easily separated into horizontal and vertical velocity components and high accuracy line of sight (LOS) range measurements. This dual mode of operation can provide useful information, such as vehicle orientation relative to the direction of travel, and vehicle attitude relative to the sensor footprint on the ground. System performance was evaluated in a series of helicopter flight tests over the California desert.